AFRICAN FRESHWATER SPONGES: *MAKEDIA TANENSIS* GEN. ET SP. NOV. FROM LAKE TANA, ETHIOPIA

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The new genus *Makedia* is described and illustrated from shallow waters of Lake Tana, Ethiopia. Its morphological distinguish traits are characterised and discussed in comparison with those genera belonging to genera *incertae sedis* from ancient lakes of the world. ❐ *Porifera, Demospongiae, Makedia tanensis, new genus, new species, taxonomy, scanning electron microscopy, Ethiopian region, biodiversity, endemism, ancient lakes, geographic distribution.*

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Africa has a rich freshwater sponge fauna, so far containing about 60 species of Spongillidae (8 genera), Potamolepidae (2 genera), Metanidae (1 genus), and 4 genera with still undefined taxonomic status (Hilgendorf, 1883ab; Marshall, 1883a,b; Weltner, 1895, 1898, 1913; Evans, 1899; Kirkpatrick, 1906, 1907; Annandale, 1909, 1914; Jaffè, 1916; Schouteden, 1917; Stephens, 1919; Burton, 1929ab, 1934, 1938; Seurat, 1930; Topsent, 1932ab; Arndt, 1933,1936; Schroeder, 1934; Tuzet, 1953; Brien & Govaert-Mallebrancke, 1958; Lévi, 1965; Brien 1967, 1968abc, 1969abc, 1970ab, 1972, 1973, 1974, 1975; Boury-Esnault, 1980; Vacclet et al., 1991; Gugel, 1993).

The most extensive reviews of this fauna are the synopsis of Arndt (1936) and the worldwide revision of Penney & Racek (1968). The cosmopolitan family Spongillidae Gray, 1867, is widespread in African freshwater habitats ranging from: wadi in Sahara; large perennial rivers such as Nilo, Zambesi and Congo; to ancient lakes and man-made basins. Nevertheless, there are some genera and/or species of Potamolepidae Brien, 1967, and Metanidae Volkmer-Ribeiro, 1986, that are endemic to few hydrographic basins in Western and Central Africa. Finally, Brien (1972, 1973) suggested the erection of the new sub-family Globulospongillinae to define the status of the endemic genus *Malawispongia* Brien, 1972, known from the Mid-Pleistocenic Lake Malawi/Nyasa.

In this paper we describe a new genus *Makedia* n.g., with type species *Makedia tanensis* sp. nov., from the Pleistocenic Lake Tana in the NW marginal area of the African Rift Valley. Prior to the present study only Arndt (1936) had reported on sponges from Abyssinia, recording an unidentified freshwater species.

MATERIALS AND METHODS

In a preliminary survey of the freshwater sponge fauna of N Ethiopia and Eritrea, in 1988-1989 ten water courses and lakes were sampled. Of these sites sponges where found only in Lake Tana, although sampling was performed under severe constraints represented by the civil war and particularly by the endemic schistosomiasis in the lake.

Sponges were collected in shallow waters along the S coast of Lake Tana at Bahir Dar (11°36'N, 37°23'E), NW Ethiopia in May 1988 (Fig. 1). Specimens were preserved dry. All specimens, microscope slides and SEM stubs are presently registered in the senior author's collection at the Istituto di Zoologia dell'Università, Genova (IZUG), to be deposited in the Museo Civico di Storia Naturale G. Doria, Genova (MCSNG), Italy.

An entire specimen (FW250) and fragments of specimen FW280 were sputtered coated with gold and observed under scanning electron microscopy (SEM) to define skeletal characters. Spicules from FW250, 251, 279, 280 were dissociated by boiling sponge fragments in nitric acid, washing in water, and dehydrating in

TABLE 1. Morphological diagnostic traits of some freshwater sponges from ancient lakes of the world that do not produce gemmules. Data based on original descriptions and a preliminary study of holotypes by the authors.

Species	Lakes	Characteristics
Makedia tanensis gen. et sp. nov.	Lake Tana Ethiopia	1) undifferentiated ectosome; 2) alveolate isotropic choanosomal skeleton with paucispicular fibres; 3) sparse spongin; 4) oxeas ranging from slender to stout, straight to slightly curved, from smooth to variably ornamented; acerate tips; 151-285/5-22µm;
Balliviaspongia wirrmanni Boury-Esnault &Volkmer-Ribeiro, 1992	Lake Titicaca Perù	1) ectosome an irregular network of uni- or bi-spicular meshes tangential to the surface; 2) reticulate irregular choanosomal skeleton with multispicular primary tracts and paucispicular irregular secondary tracts; 3) sparse spongin; 4) oxeas ranging from slender to stout, from straight to slightly curved, from smooth to spined; acerate tips; 153-450/2.6-13µm
Cortispongilla barroisi Topsent, 1892	Lake Kinneret Israel	1) undifferentiated ectosome; 2) reticulate choanosomal skeleton with multispicular primary tracts and paucispicular secondary tracts more dense toward the surface; 3) sparse spongin; 4) oxeas ranging from slender to stout, from straight to slightly curved, from smooth to granulated; acerate tips; 180-370/30-33µm
Ochridaspongia rotunda Arndt, 1937	Lake Ohrid Macedonia	1) undifferentiated ectosome; 2) reticulate choanosomal skeleton with multispicular primary tracts, diverging in tufts toward the apical surfaces and paucispicular irregular secondary tracts; 3) sparse spongin; 4) oxeas ranging from slender to stout, from straight to slightly curved, from smooth to spined; acerate tips; 180-367/5-23µm
Malawispongia echinoides Brien, 1972	Lake Malawi Malawi	1) undifferentiated ectosome; 2) reticulate multispicular choanosomal skeleton with primary tracts diverging in tufts toward the apical surfaces and irregular secondary tracts; 3) abundant spongin; 4) oxeas ranging from slender to stout, from straight to slightly curved, from smooth to spined; acerate to blunt tips; 190-240/4-10µm
Ohridospongilla stankovici Gilbert & Hadzisce, 1984	Lake Ohrid Macedonia	1) undifferentiated ectosome; 2) alveolate isotropic skeleton with pauci-(multi-?)spicular fibres; 3) sparse spongin; 4) oxeas ranging from slender to stout, from straight to slightly curved, from smooth to spined; acerate tips; ?
Pachydictyum globosum Weltner, 1901	Lake Poso Sulawesi	1) undifferentiated ectosome; 2) reticulate multispicular skeleton with primary tracts, diverging in tufts toward the apical surfaces, and multispicular irregular secondary tracts; 3) sparse spongin with abundant foreign material; 4) stout oxeas, straight to slightly curved, varying from smooth to spined; tips range from acerate to blunt; 220-410/30-64µm
Spinospongilla polli Brien, 1974	Lake Tanganika Zaire	1) ectosome an irregular network of uni- or bi-spicular meshes tangential to the surface; 2) alveolate isotropic multispicular choanosonal skeleton with rare scattered smaller oxeas (128/2.3µm); 3) sparse spongin; 4) oxeas ranging from slender to stout, from straight to slightly curved, from smooth to spined and granulated; tips range from acerate to blunt; 160-208/11-12µm

alcohol. Suspended spicules from each specimen were dropped on slides for light microscopy; SEM analysis was performed on spicules sputter-coated in gold sputtering. Seventy spicules, photographed by SEM, were measured from specimens FW251 and FW280; mean and standard deviation of measurements were calculated (in µm).

SYSTEMATICS

Class **Demospongiae** Sollas
Order **Haplosclerida** Topsent
Family **incertae sedis**

Makedia new genus

TYPE SPECIES. *Makedia tanensis* sp. nov., monotypic.

ETYMOLOGY. Named for the Abyssinian Queen of Saba, Makeda.

DIAGNOSIS. Spongillid-like sponge with skeleton shaped as an alveolate isotropic paucispicular network with sparse spongin. No ectosomal differentiation present. Megascleres are oxeas ranging from completely smooth to granulated, tuberculated and/or strongly spined; spines acutely slanting with a globular base, named drop-like spines, with an evident axial canal. Microscleres and gemmules absent.

Makedia tanensis new species
(Figs 2-3)

MATERIAL. HOLOTYPE. IZUG-FW251: Bahir Dar, Lake Tana, NW Ethiopia, coll. R. Manconi, -.v.1988. PARATYPES. IZUG-FW250, IZUG-FW279, IZUG-FW280: same locality, coll. R. Pronzato, -.v.1988.

ETYMOLOGY. Named for the type locality, Lake Tana.

DESCRIPTION. FW250. Whitish encrusting sponge (0.5x0.2x0.1cm) on a pebble at a depth of 15cm. FW251. Whitish encrusting sponge (0.5x0.8x0.5cm) on the lateral side of a boulder at a depth of 5cm. FW 279.Two whitish thin contiguous crusts (0.5x0.7cm and 0.3x0.3cm), within the same concavity of a cobble, on the dried shoreline. FW280. Brown crust (1x2x 0.2cm) covered by unidentified epi- and

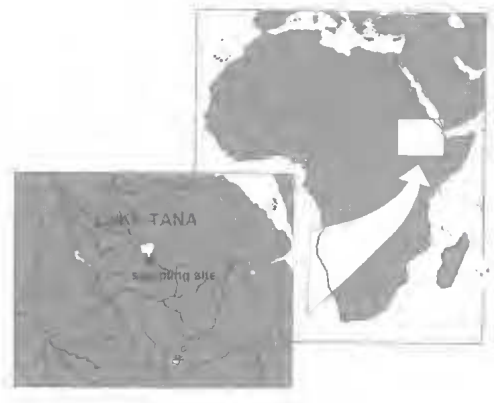

FIG. 1. Geographical position of the type locality of *Makedia tanensis* along the coast of Tana Lake in NW Ethiopia.

endobionts on the lateral surface of a cobble at 20cm depth. All specimens share the following traits. Encrusting body shape small in size, up to 0.5cm thick, 2cm diameter (Fig. 2A). Consistency was soft and fragile. Surface was hispid (Fig. 2B,C), oscules were not conspicuous (Fig. 2A). Ectosome was undifferentiated from choanosome macroscopically. Isotropic alveolate choanosomal skeleton with paucispicular fibres and scanty spongin (Fig. 2B,C). Megascleres range from slender to stout, straight or slightly curved oxeas, smooth to variably spined with apices from smooth to spiny acerate (Fig. 3A). Spicules have a wide morphological variety of irregularly scattered sculpturing, ranging from granules (Fig. 3C-H), granulated tubercules (Fig. 3C-E), drop-like granulated spines (Fig. 3C), to large acute spines (Fig. 3E). Two or more of these sculptures are associated on the same or in different oxeas. Atypical apices were also frequently observed on spicules (Fig. 3B). Lengths/widths of megascleres are as follows: FW251, 151-285/6-16µm (mean 210/11; standard deviation 26/2.5); FW280, 184-289/5-22µm (233/13; 27/3). Microscleres and gemmules are absent.

HABITAT. Dry and living sponges were found on the dried shoreline and in shallow standing waters up to 20cm depth, associated with gastropods, bivalves and triclads on the lower or lateral surfaces of littoral volcanic pebbles, cobbles and boulders. The Pleistocenic volcanic Lake Tana, the largest in Ethiopia with a surface of about 3150km^2 and a maximum depth of 14m (mean 8m), is tributary of the Nilo basin with its single outlet the Blue Nile (River Abbay); located in the N highlands of Ethiopia at an altitude of about 1800m the lake is characterised by a strong seasonality in rainfall and water level; the rainy and wet seasons occur in summer and winter, respectively, with recurrent long lasting drought periods; water level range is about 0.4-2.30m and reaches its maximum about 2 months after the peak of the rainy season (Bini, 1940a; Nagelkerke & Sibbing, 1996).Waters are characterised as oligotrophic; water temperature range is 15.6-20°C; silica is 9-16 mg/l (Bini, 1940a; Rzoska, 1976). The lake is isolated downstream by the Tis Issat Falls, and hosts a scarcely diversified fauna with the exception of fishes and nematods (Bini, 1940b; Brunelli, 1940; Brunelli & Cannicci, 1940; Nagelkerke et al., 1995; Abebe, 1996).

DISCUSSION

Cyclic disturbances produced by seasonal water level fluctuations in the littoral zone largely influences sponge populations, notably inducing stressed conditions and small body size of specimens. In spite of the suboptimal habitat, where unfavourable conditions are linked to the alternation of the wet and dry seasons, gemmules were absent in all specimens of *M. tanensis* on the dried shoreline, or in very shallow waters of Lake Tana. The absence of gemmules in May, at the end of the dry season, strongly supports the hypothesis that this species is not able to produce resistant bodies. Several data, however, suggest that the production of gemmules is not necessary obligatory in the life history of all freshwater sponges, as shown in Lubomirskiidae from Lake Baikal (Rezvoi, 1936), which have lost their ability to reproduce asexually by means of gemmules (Efremova, 1994), and in other genera from ancient lakes of the world.

The recognition of a new species, *Makedia tanensis*, in a new monotypic genus, is supported by the possession of peculiar ornamentations on oxeas. This isolated monotypic taxon fits the trend shown by several authors, such as Topsent (1892), Weltner (1901), Arndt (1937), Brien (1974), Gilbert & Hadzisce (1984), Boury-Esnault & Volkmer-Ribeiro (1992), indicating that most freshwater sponges in isolated, ancient lakes belong to monotypic genera - with the sole exception of *Ochridaspongia* Arndt *(O. rotunda* Arndt, 1937, and *O. interlithonis* Gilbert &

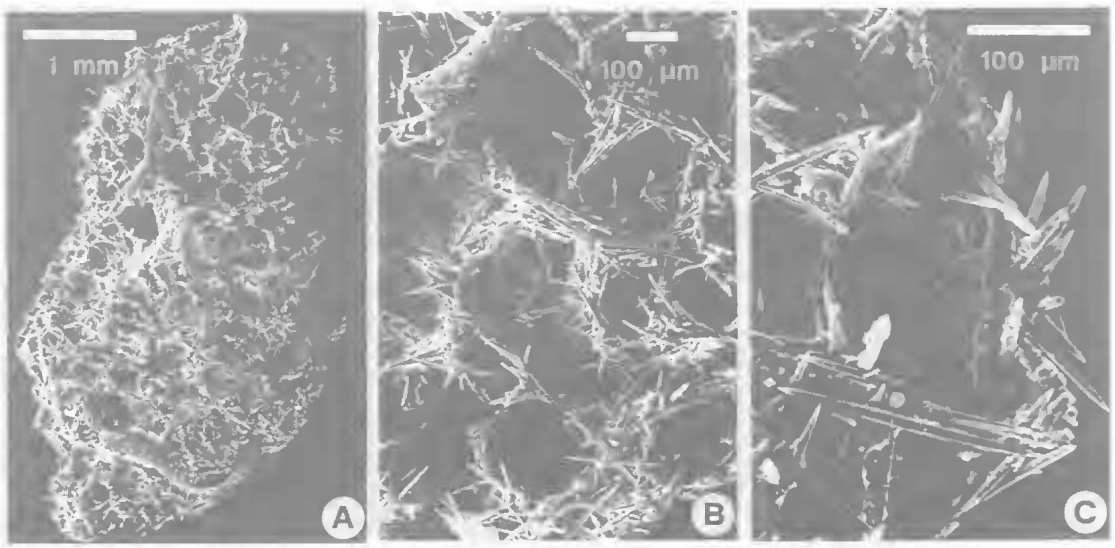

FIG. 2. *Makedia tanensis* sp. nov. (paratype IZUG-FW250). A, Entire specimen. B, Choanosomal alveolate skeleton. C, Surface hispidation.

Hadzisce, 1984), presently assigned to Lubomirskiidae. These genera have some morphological affinities, but their life histories are poorly known, they are highly disjunct in their distributions. The question, therefore, remains as to their higher taxonomic affinities.

The new genus *Makedia* is characterised by a spongillid-like skeleton, with a peculiar range of ornamentations on spicules, and the absence of microscleres and gemmules. A comparative analysis, in the framework of a general revision of freshwater sponge taxa, of the type material and original descriptions of genera from ancient lakes, show that these taxa share the following traits (Table 1) with the genus *Makedia*: 1) they are monotypic; 2) known only from the type locality; 3) inhabit tectonic or volcanic lakes with high levels of endemism; 4) the skeleton is a network of ornamented oxeas with multi- or pauci-spicular choanosomal tracts or fibres; 5) ectosomal skeleton, if present, uni- or bi-spicular; 6) they do not produce microscleres; 7) they do not produce gemmules. However diagnostic skeletal traits highlight a morphological divergence within this group of sponges from ancient lakes. *Makedia*, *Spinospongilla* and *Ohridospongilla* share the spongillid-like alveolate skeletal trait; on the other hand *Cortispongilla, Ochridaspongia, Pachydictyum, Malawispongia* and *Balliviaspongia* (Table 1) share the reticulate choanosomal skeleton. All these genera are amalgamated provisionally into one *incertae sedis* group because of their disjunct distribution and the high possibility of convergence as occur in other taxa of ancient lakes.

Some other genera and species *incertae sedis*, such as *Metschnikowia* and *Nudospongilla* (in part), could also be included in this group in the future but this requires more detailed examination of their type material as to their true morphological characters (Manconi & Pronzato, in preparation).

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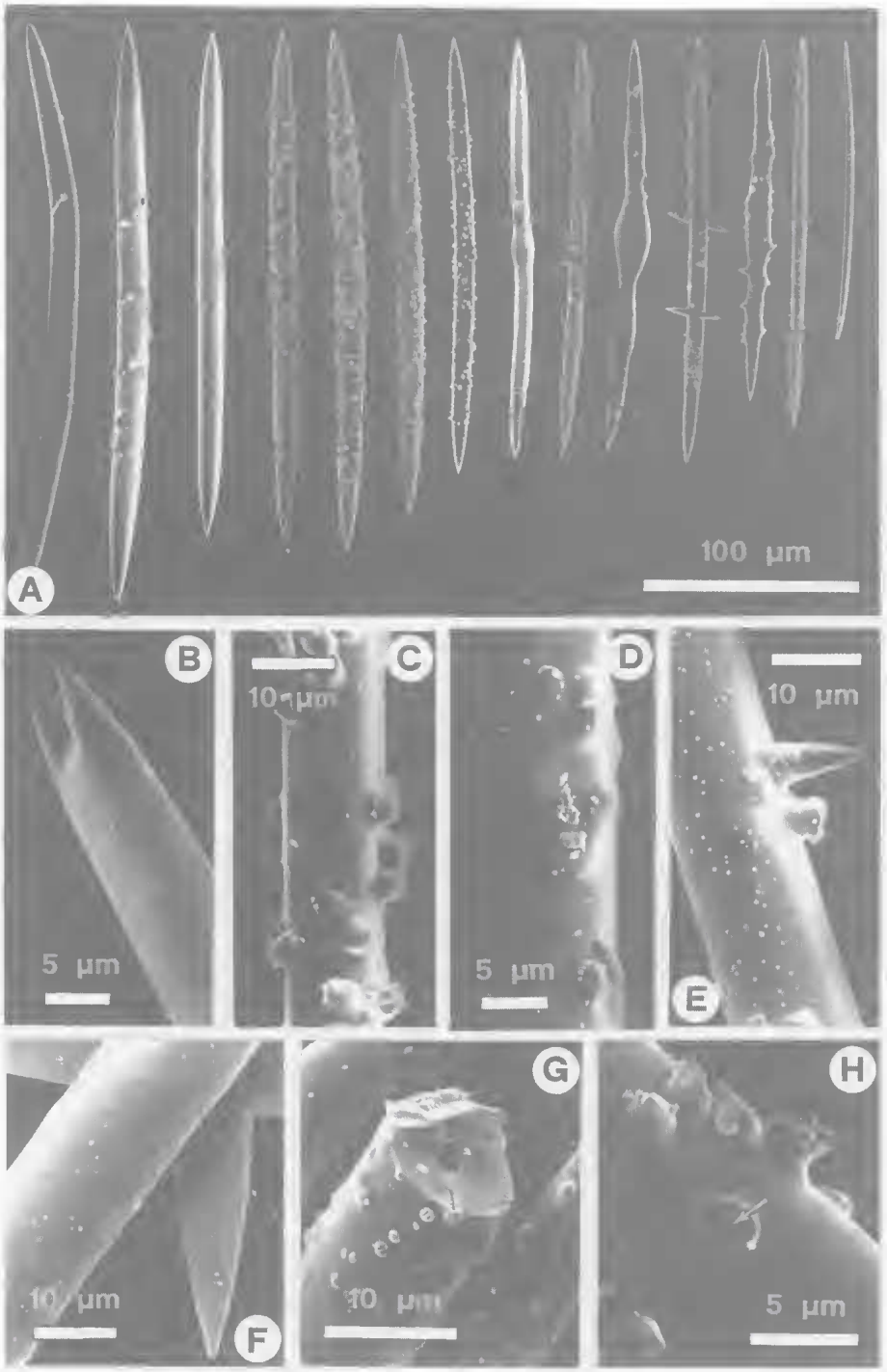

FIG. 3. *Makedia tanensis* sp. nov. (holotype IZUG-FW251). A, Dimensional and morphological variety of megascleres ranging from smooth to granulated, tuberculated and spined oxeas. B, Atypical apex of an oxea. C-D, Surface of oxeas with granules, tubercules and drop-like spines. E, Isolated large spine and tubercule on a finely granulated oxea. F, Surface of a finely granulated oxea. G-H, section of a granulated oxea with an axial canal extending toward a granule (arrow).

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